

SINGLE-WELL SEISMIC IMAGING

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RESEARCH OBJECTIVES

The continuing objective of this project is to identify and provide solutions to fundamental issues surrounding single-well seismic imaging to evaluate and develop the technology in a timely and cost-effective fashion. Single-well imaging is in its infancy, and there are many unanswered questions, but only limited resources to address them. Therefore, this technology must be developed in an efficient and logical manner to quickly identify the fundamental attributes that must be included in a total methodology. Such development must occur while leveraging the best-available resources to ensure the technology's successful application and acceptance.

APPROACH

The work is an integrated approach to spur the development and application of a new technology much more quickly than if it were left to individuals working separately. The project is meant to leverage resources to address issues that would not be addressed by individual companies. It is a coordinated effort between three national laboratories working closely with industry and involving university support. In addition to Berkeley Lab, the other participating laboratories are Idaho National Engineering and Environmental Laboratory (INEEL) and Sandia National Laboratories. It recognizes that in a time of shrinking funds, we have an obligation to spend wisely, while creating and maintaining fairness of opportunity to the industry (as well as bringing the appropriate capabilities of the national laboratories to complement and catalyze industry's efforts in this area).

The proposed work consists of four interdependent activities. These activities comprise facets of the technology required for the ultimate successful development of single-well seismic imaging and (to some degree) crosswell imaging:

- Hardware: sources/receivers, telemetry/recording, bore-hole noise effects, deployment
- Modeling: synthetic seismograms, parametric studies, inversion, designs for hardware/surveys
- Field testing: quality data sets, evaluation/validation at well-characterized sites.
- Data processing and interpretation: algorithms, 3D imaging, noise reduction, visualization.

ACCOMPLISHMENTS

Several single-well surveys were run at Chevron's Lost Hills oil field in Central California. The objective of the work was to perform time-lapse imaging of a CO₂ flood in the diatomite. In August 2000 and May 2001, two separate surveys were run to gain data before injection and after injection, respectively. Additional objectives were to test tube-wave damping with a device designed and fabricated by INEEL. In each survey, different configurations of sources and receivers were run, using a high-frequency piezoelectric source (500 Hz to 200 Hz) and a low-frequency orbital source with both hydrophones and three component geophones. In the tube-wave experiments, a 10–16 dB reduction of the tube wave was obtained with the INEEL tube wave attenuator. Figure 1 shows an example of the single-well data obtained in the baseline test.

ACKNOWLEDGMENTS

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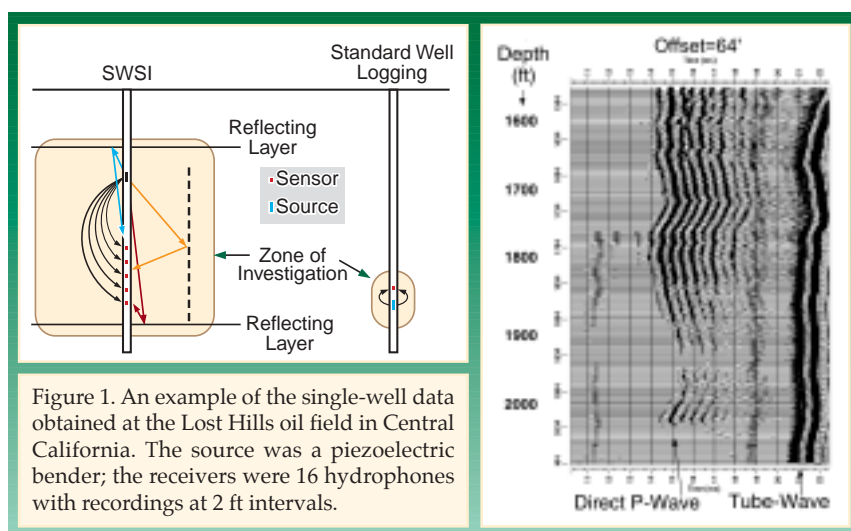


Figure 1. An example of the single-well data obtained at the Lost Hills oil field in Central California. The source was a piezoelectric bender; the receivers were 16 hydrophones with recordings at 2 ft intervals.